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Fagineura crenativora, a New Genus and Species of Sawfly (Hymenoptera, Tenthredinidae, Nematinae) Injurious to Beech Trees in Japan

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Abstract A new genus and species, *Fagineura crenativora* Vikberg et Zinovjev (Hymenoptera, Tenthredinidae, Nematinae) is described on the basis of the material from Hokkaido, Honshu, Shikoku and Kyushu, Japan. In the last several years, the larvae of this species severely defoliated beech trees on the Tanzawa Mountains and Mt. Mitôsan in central Honshu. The biology of this sawfly is briefly described.

Key words: Hymenoptera, Tenthredinidae, *Fagineura crenativora*, new genus, new species, *Fagus*.

Introduction

Beeches (*Fagus*) are very important deciduous broad-leaved trees representing northern temperate forests in northern hemisphere. With about ten world species, they show disjunct distribution in Europe, eastern Asia and eastern North America. Unlike other broad-leaved trees commonly occurring in the same regions, such as *Betula, Alnus*, *Salix*, *Prunus* or *Acer*, *Fagus* harbors only a few sawfly species. In Japan, two species have been recorded as leaf-feeders on beech trees, a nematine, *Priophorus hyonosanus* Okutani, 1959 from western and central Honshu and an undetermined leaf-miner found on Mt. Hakusan in Ishikawa Prefecture, central Honshu (Togashi, 1997). The holotype of *P. hyonosanus* was reared from larva feeding on *Fagus crenata* Bl. on Mt. Hyonosen in Hyogo Prefecture, western Honshu (Okutani, 1959). This species was recently recorded from Fukui Prefecture (Haneda *et al.*, 1998) and Ishikawa Prefecture (Togashi, 1998), both in central Honshu. These references are the

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only published information on the two sawfly species associated with beech in Japan.

In Europe, three species of sawflies are known to feed on *Fagus*, a cimbicid, *Cimbex fagi* Zaddach, 1863, and a tenthredinid, *Nematus fagi* Zaddach, 1876, both rare species feeding only on *Fagus sylvatica* L., and another tenthredinid, *Caliroa annulipes* (Klug, 1816), a polyphagous species attached also on *Tilia*, *Salix*, *Betula*, etc. *Nematus fagi* has been recorded from S. Europe (Balkan peninsula, Italy), W. and C. Europe (from Ireland and France to Romania) and Ukraine (wrongly cited as European Russia in Liston, 1995). The northernmost localities are Perthshire, Scotland and S. W. Finland, Alandia (=Ahvenanmaa, Sund, 60°18′N), where the larvae were found on cultivated trees (Vikberg, 1984). The larva, which was figured by Zaddach (1876), is a solitary leaf edge-feeder and has no "extra" molt after feeding period on the food plant. The female of *N. fagi* is very similar to that of *Nematus* [=*Pteronidea, Hypolaepus*] *miliaris* Panzer. The saws of these species have not yet been distinguished from each other according to Benson (1958: fig. 724). Recent taxonomic works differ in their treatment of the genus *Nematus* sensu lato. Lacourt (1998, 1999) split it into the genera *Nematus* Panzer, *Lindqvistia* Lacourt, *Kontuniemiana* Lacourt, and *Hypolaepus* Kirby (=*Holcocneme* Konow) with two subgenera *Pteronidea* Rohwer and *Paranematus* Zinovjev; thus *Nematus fagi* is called *Hypolaepus* (*Pteronidea*) *fagi* (Zaddach) in his system. In a more conventional treatment, this species has been called *Nematus fagi* Zaddach (Taeger *et al.*, 1998) or *Nematus* (*Pteronidea*) *fagi* Zaddach (Zhelochovtsev, 1988; Liston, 1995). In North America, no sawflies are known to feed on *Fagus* (Smith, 1979).

In the last decade, an unidentified nematine sawfly species occurred in outbreak proportions and caused serious defoliation in the beech forests on the Tanzawa Mountains (highest peak, Mt. Hirugatake, 1673 m), Kanagawa Prefecture, and on Mt. Mitôsan (1528 m) in the western end of Tokyo Metropolis, both in central Honshu, Japan. The outbreak was first observed near the summit of Mt. Tanzawasan (1567 m) in the Tanzawa Mountains in 1993 (Yamagami *et al.*, 1997 a) and then various localities on the Tanzawa Mountains and Mt. Mitôsan in 1997–1999 (Yamagami *et. al.*, 1997 b, 1998, 1999; Momosawa, 1999, 2000; Yamagami, unpublished). Our studies have shown that this nematine sawfly is new to science. Superficially it looks similar to the species of *Nematus* sensu lato, but its saw is very different from that of *Nematus fagi*. Moreover, it is not closely related to any subgroups of *Nematus* sensu lato and we describe it as a new species of a new genus, *Fagineura crenativora* Vikberg et Zinovjev, in the following lines. Measurements were done as described in Zinovjev and Vikberg (1999).

Fagineura Vikberg et Zinovjev, gen. nov.

Medium-sized, slender species of Nematinae with long antennae. Mandibles

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symmetric, rather narrow, gradually tapering from base to apex, without carina in apical half. Pleural suture of metapleuron in upper anterior part somewhat bent and very close to membranous part of thorax. Anterior third of mesopleural katepimeron glabrous, posterior part pilose. Venation of fore wing as in other Nematini (without radial cross vein, anal cell petiolate). Legs unmodified, claws bifid. Sawsheath short, shorter than cerci, in dorsal view broad, distinctly but shallowly emarginate apically. Lancet broad, with pores on tangium. Lance triangular with broadened base. Larva without cerci, feeding on *Fagus*; with "extra molt" after feeding period; in prepupa color pattern and glandubae lost, setation becoming shorter.

Resembles *Nematus* sensu lato [=*Hypolaepus*, *Holcocneme*, *Pteronidea*] but differs in having pores on the tangium and in less derived shape of the mandibles (resembling *Dineura* type); from almost all species of *Nematus*, it differs in hairy katepimeron of the mesopleuron and the apically emarginate sawsheath. It is separated from *Pristiphora* and its related genera by the costa of the forewing less dilated, the shape of the penis valve resembling *Nematus*, and the larva having the stipes with 2 setae and an extra molt. It does not fit *Mesoneura* because the forewing has no radial cross veins and the costa is narrower.

Type species: *Fagineura crenativora* Vikberg et Zinovjev, sp. nov.

Fagineura crenativora Vikberg et Zinovjev, sp. nov.

[Japanese name: Buna-habachi]

Female (holotype, Fig. 1 A–B, E–G). Head including orbitae pale, lower part whitish, upper part darker, yellowish to brownish; frons black, postocellar area black with brown spots; back of head almost entirely black; area around anterior tentorial pit black. Antenna blackish, slightly brownish apically on underside. Prothorax mostly pale yellowish, anterior margin of pronotum and part of propleuron black. Mesonotum black, with brownish coloration on hind parts of lateral lobes. Mesoscutellum brownish, with blackish margins. Tegula pale. Metanotum almost totally black. Mesopleuron pale yellowish brown. Metapleuron pale yellowish. Wings clear, stigma brownish. Venation mostly dark brown; base and front margin of costa and anterior margin of R+Sc pale, basal half of A1 pale. Legs pale, yellowish. Abdomen including ovipositor sheath pale yellowish to whitish; basal two terga above black, terga 3–7 dark with whitish margins.

Head: frontal area well defined, with anterior wall distinctly shallowed medially; lateral walls slightly converging posteriorly. Postocellar area short, transverse, slightly convex, anteriorly defined by deep furrow. Clypeus with broad and moderately deep (0.47) emargination apically (Fig. 1 E). Minimal malar space 0.3 of diameter of antennal socket. Mandibles symmetrical, left mandible narrow, rather gradually tapered to apex, without carina (Fig. 2 A). Antenna slender, 1.18 as long as costa of the forewing. Metapleuron as in Fig. 2 B. Forewing with base of vein 2A+3A incom-

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plete; vein Sc a little basad or interstitial with origin of vein M from R. Claws bifid: inner tooth long, slender, slightly shorter than apex, parallel to it.

Hairs on clypeus, labrum and bases of mandibles very long, at least 3 times as long as those elsewhere on head. Mesoscutum and mesoscutellum shiny, punctured, posttergite shining with more dense punctures. Mesepisternum densely pubescent on upper part and sparsely pubescent on lower part, with a glabrous zone between. Mesepimeron: anterior third of katepimeron glabrous, posterior part pilose. Abdominal terga with rather dense microsculpture, and especially terga 4–7 with rather dense punctation.

Sawsheath short, broad, apically shallowly emarginate (as in many species of *Pristiphora*); cerci reach further back than sheath, with rather short setae (Fig. 2 C). Saw (studied in holotype and two paratypes): lancet with lamnium short, triangular, with 15 segments, radix a little longer than lamnium. Tangium with ca. 5 pores; ctenidia in 3 to 4 rows, broader above than below. In basal rows ctenidia are long and narrow, in apical rows ctenidia are short, broad, triangular (Fig. 3 A). Lance broad triangular (Fig. 1 G).

Measurements of the holotype. Body 7.2 mm, fore wing 6.5 mm, head width 1.80 mm, thorax width 2.25 mm; left mandible: length 0.80, basal width 0.35 mm. Compound eye 0.73×0.52 mm. Antenna ca. 4.5 mm, 1st flagellomere 0.63 mm, length/width 4.0, 2nd flagellomere 0.78 mm, 3rd flagellomere 0.73 mm. Costa 3.8 mm. Hind femur: length including trochantellus 1.87 mm, without trochantellus 1.67 mm, height 0.40 mm; hind tibia 2.23 mm, hind tarsus 2.03 mm; inner hind tibial spur 0.30 mm; 1st metatarsomere 0.70 mm. Basal plate (valvifer 2) and sawsheath (valvula 3) combined 1.12 mm (basal plate 0.53 mm, sawsheath 0.65 mm); cercus 0.33 mm.

Female variations. Length: 5.5–9.2 mm. Variable in coloration even in specimens from the type locality (Mt. Tanzawasan). Some females distinctly darker, some distinctly paler than the holotype; wing venation can be darker or paler; bases of coxae and trochantelli can be blackish; antenna more brownish or more blackish. Color of mesonotum varies from entirely reddish brown to entirely black; mesepisternum may have dark large spot or area anteriorly, mesepimeron can be partly black. In one pale female blackish color is diminished to minimum: around ocelli a little, some transversal stripes on abdominal terga 1–5; wing venation and stigma in this specimen all pale yellowish. In some females, punctation on the abdominal terga can be almost invisible. In one dark female from Minoto, frontal orbits black, thorax above and abdomen above black; mesopleuron with rather extensive black color. In another dark specimen from Mt. Kunimiyama, 1st tergum rather shining, without setae. In some females (e.g., in two specimens from Ehime) the walls of frontal area are less

Fig. 1. *Fagineura crenativora* Vikberg et Zinovjev, gen. et sp. nov. A–B, E–G, Holotype female; C–D, H, paratype male from the summit of Mt. Tanzawasan. E, Head in facial view; F, H, head in dorsal view; G, tip of abdomen in lateral view.

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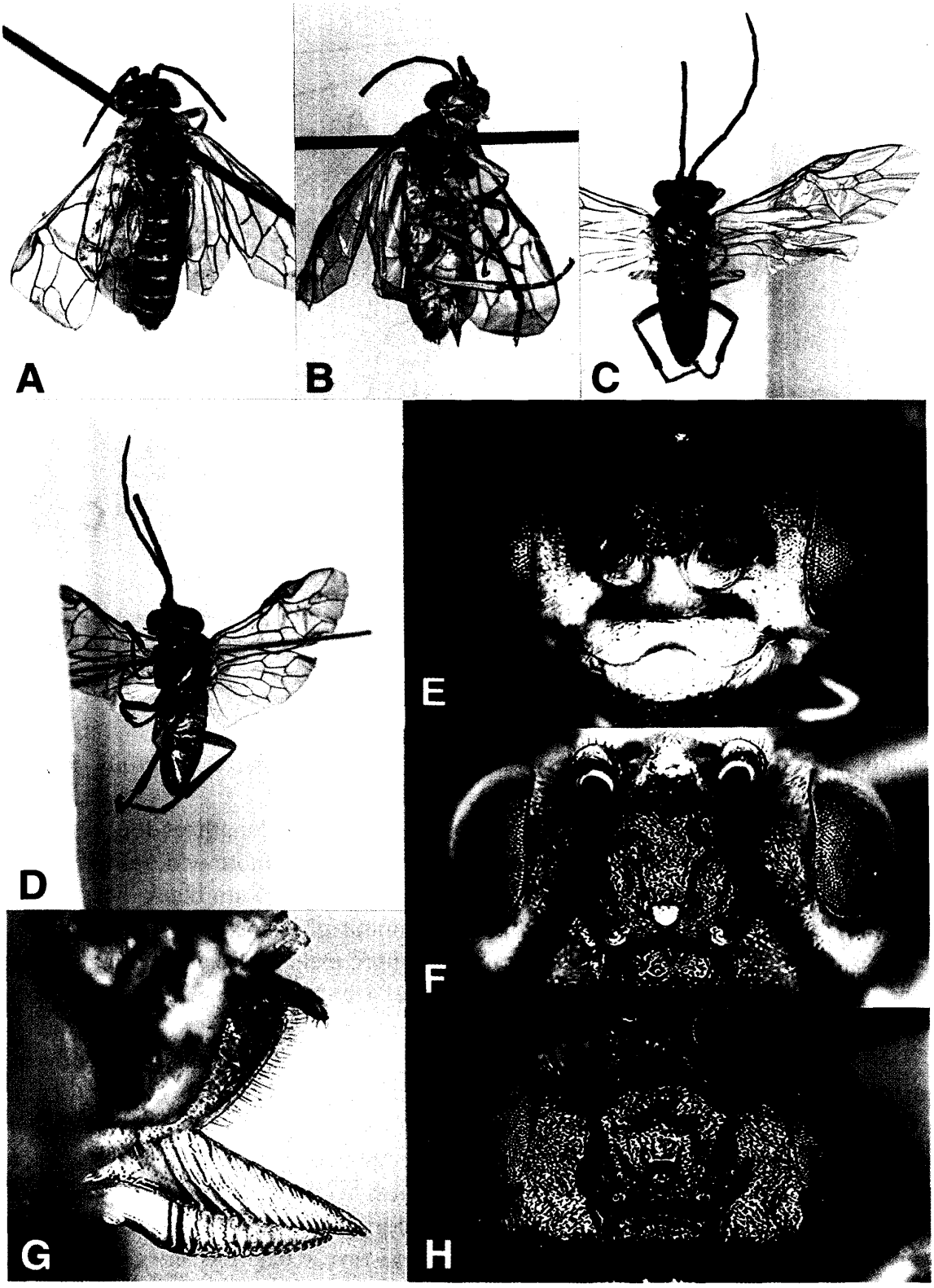

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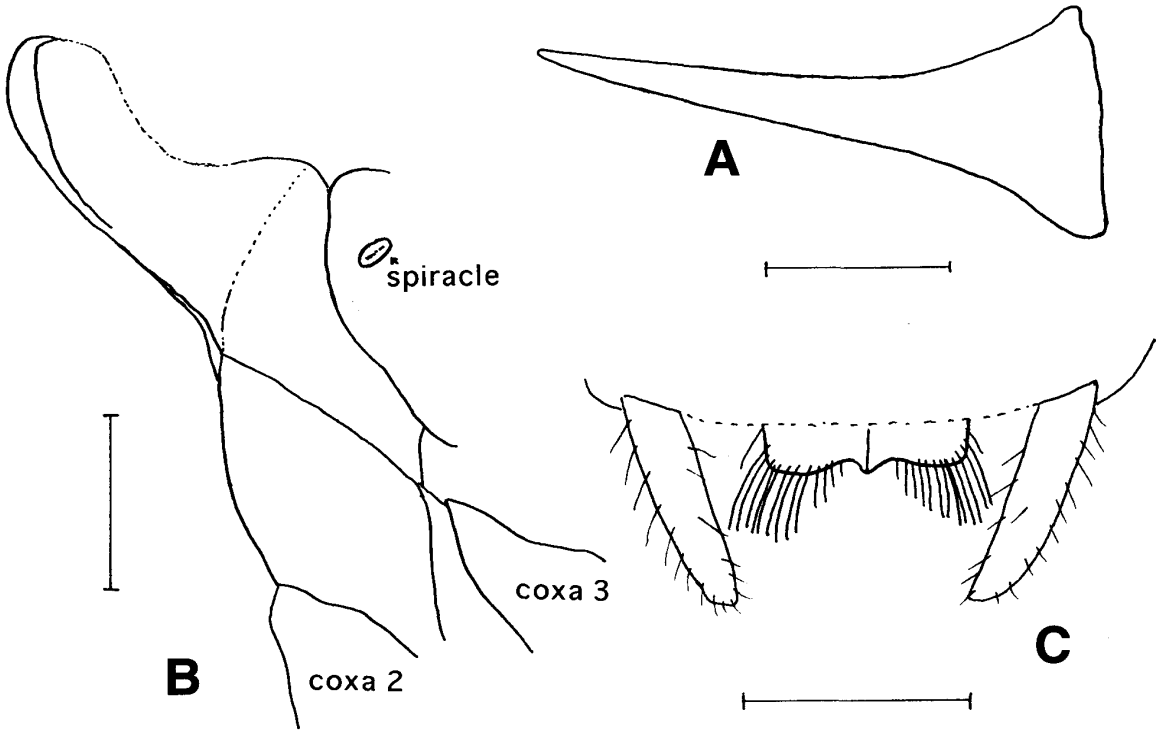

Fig. 2. *Fagineura crenativora* Vikberg et Zinovjev, gen. et sp. nov., paratype female from the summit of Mt. Tanzawasan. A, Left mandible in lateral view; B, left metapleuron in lateral view; C, sawsheath and cerci in dorsal view. Scales: 0.25 mm.

defined, in some others clypeus is abnormal. In a few females, glabrous zone of mesepimeron is almost absent.

Male (Fig. 1 C–D, H). Length of body 5.4–5.9 mm, length of fore wing 6.0 mm. Length of antenna 5.0–5.2 mm. Head with darker color more widespread than in female, e.g. frontal orbits black. Mesoscutum and mesoscutellum black. Mesepisternum with black spot anteromedially, usually without glabrous zone. The pale coloration starting from third abdominal tergum is more extensive than in female; terga with stronger and thicker punctation. Projection of 8th tergum small, medially slightly carinate, apically rounded. Penis valve in lateral view Fig. 3 B.

Measurements of a captured male from the type locality. Length of body 5.9 mm, fore wing (from tegula) 6.0 mm. Head width 1.66 mm, thorax width 1.9 mm. Antenna 5.6 mm. First flagellomere: length 0.75 mm, length/width 4.0, 2nd flagellomere 0.97 mm, 3rd flagellomere 0.88 mm. Compound eye 0.75×0.55 mm. Costa 3.2 mm. Hind femur: length including trochantellus 1.78 mm, height 0.33 mm. Hind tibia 2.0 mm, hind tarsus 2.0 mm. Length of hypopygium 1.3 mm. Projection of 8th tergum: length 0.17 mm, width together with lateral foveae 0.5 mm.

Full grown larva (Fig. 4 F). Length of body ca. 12–13 mm, diameter of head capsule 1.76–1.88 mm (n=23, one larva going to molt 1.64 mm). Head pale, yellow-

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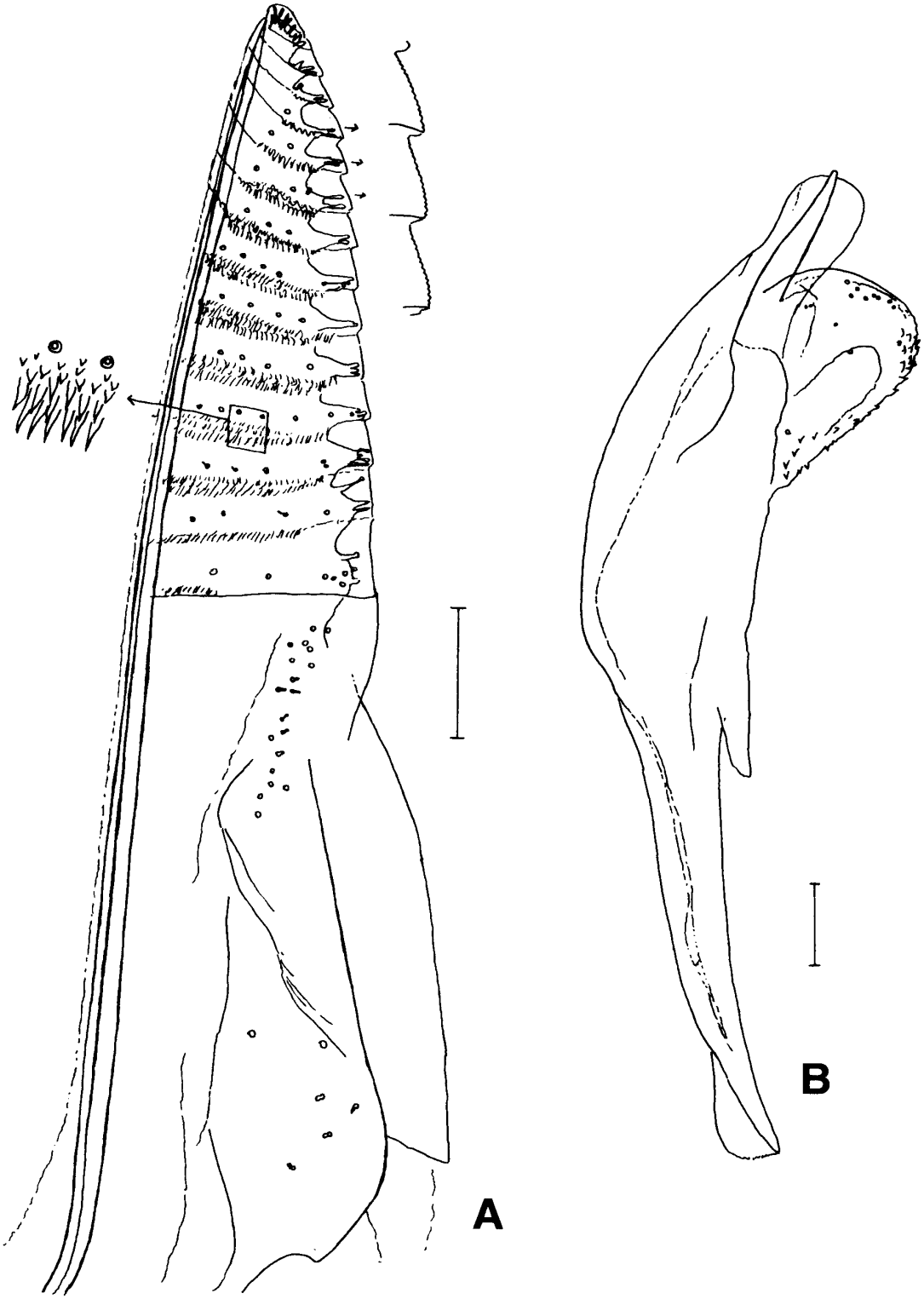

Fig. 3. *Fagineura crenativora* Vikberg et Zinovjev, gen. et sp. nov. A, Lancet (saw) of a paratype from the summit of Mt. Tanzawasan; B, penis valve in lateral view of a paratype from the summit of Mt. Tanzawasan. Scales: 0.1 mm.

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ish white. Vertex around coronal suture pale, on either side on the posterior part of vertex brownish black spot which narrows and becomes paler in anterior direction. The anterior vertex pale brownish spotted. Upper part of frons reddish brown. On posterior side of temple a narrow brownish black vertical stripe. Frons with 12–16 setae, clypeus with 2 setae on both sides, labrum 2 setae, rarely 3 setae on one side, mandible with one seta, stipes 2 setae, palpifer with 2 setae. Antenna short, conical, with 5 segments.

Body pale (greenish in life). Substigmal lobes on abdominal segments 1 to 7–8 black, with narrow, conical glandubae on pale spots. Surpedal lobes on abdominal segments 1–6 with interrupted black coloration. Black coloration also on lateral lower lobes of thoracic segments and near the base of thoracic legs. Third abdominal segment with 6 annulets; annulet 2 with 6 small setae, annulet 4 with 3 setae and 2 glandubae; 1st poststigmal lobe with 3 setae and 1 glanduba, 2nd poststigmal lobe with 4 setae or 2 setae and 1 glanduba. Stigma pale brown, without flecks anteriorly and posteriorly. Substigmal lobe with 4 setae or 3 setae and 2 glandubae. Surpedal lobe with 5 setae and 1 glanduba. Prolegs laterally with 1 small glanduba, inside near the base with 3–4 setae. Eversible glands well developed on abdominal segments 1 to 7. Anal tergum without cerci, with caudal margin rounded, with strong setae, the bases of setae strongly elevated. Anal prolegs strong, when everted strongly projecting into lateral direction (as in some Lepidoptera larvae), their base covered with several glandubae laterally.

Eonymph (prepupa). Head width 1.75–1.80 mm (n=7). Color entirely pale, whitish (greenish in life), greasy. Pale setae shorter, glandubae missing.

Cocoon. Dark brown, compact, with one wall. Size of female cocoon (n=5) 7.5–8.5×3.6–3.8 mm. Size of male cocoon (n=16) 5.4–7.2×2.7–3.5 mm.

Distribution. Japan (Hokkaido, Honshu, Shikoku, Kyushu).

Holotype. Female (pinned specimen, but it was stored in alcohol before dried). Japan, Honshu, Kanagawa Prefecture, Mt. Tanzawasan, Dôdaira, ca. 1200 m alt., reared from larva on *Fagus crenata* Bl., VI. 1997, emerged on 20. IV. 1998, A. Yamagami leg. Deposited in the National Science Museum (Nat. Hist.), Tokyo.

Paratypes. HOKKAIDO: 1 female, Mt. Kuromatsunaidake, Tozanguchi, Shiribeshi, 28–29. V. 1999, A. Shinohara leg. HONSHU: Kanagawa Pref.: 2 females, 1 male, same data as for holotype; 4 females, same locality as for holotype but 7. V.

Fig. 4. *Fagineura crenativora* Vikberg et Zinovjev, gen. et sp. nov. A, Two eggs deposited onto the veins of the sprouts of *Fagus crenata*, B, first instar larva making a round hole on the leaf; C, second instar larva; D, third instar larvae; E, larvae infesting beech leaves; F, full grown larva; G, full grown larva (below) and new prepupa (above) nearly finishing molt; H, huge number of larvae (pale elongate dots on the bark) climbing up a beech tree for molting; I, heavily damaged beech tree. A–D, F–G, Material obtained from the summit of Mt. Tanzawasan, photographs taken in the laboratory; E, H–I, photographs taken at the summit of Mt. Tanzawasan.

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1999, T. Koshiji leg.; 2 females, 8 males (originally stored in alcohol), summit of Mt. Tanzawasan, 29. IV. 1998, A. Yamagami leg.; 4 females, 1 male, same data but 7. V. 1999; 10 females (originally stored in alcohol), summit of Mt. Hinokiboramaru, 15. V. 1998, A. Yamagami leg. Yamanashi Pref.: 1 female, Masutomi, Sudama, 8. V. 1994, H. Hamaji leg. Nagano Pref.: 1 female, Minoto, 1800 m, Yatsugatake Mts., 24–26. VII. 1980, A. Shinohara leg.; 1 female, Shichimi-onsen, 4–5. VI. 1988, A. Shinohara leg. Kyoto Pref.: 1 female, Ashiu, 27. V. 1990, K. Mizuno leg.; 7 females, Omi, Ohara, 15. V. 1984, R. Inagawa leg. Nara Pref.: 3 females, Mt. Gomadanzan, Nosegawa, 23. V. 1981, K. Mizuno leg.; 1 female, Mt. Kunimiyama, 5. VI. 1988, K. Mizuno leg.; 2 females, Mt. Kunimiyama, Myojindaira, 16. V. 1982, K. Mizuno leg. SHIKOKU: Ehime Pref.: 29 females, 2 males, Tsuchigoya, Mt. Ishizuchisan, 26–27. V. 1986, A. Shinohara leg. Tokushima Pref.: 3 females, Minokoshi, Higashiiyayamason, 19. V. 1993, Y. Okushima leg. KYUSHU: Oita Pref.: 3 females, Mt. Kurodake, Kuju, 16–24. V. 1986, A. Shinohara leg.

Larval material. 24 larvae and 7 prepupae, Mt. Tanzawasan, Kanagawa Prefecture, Honshu, Japan, 13. VI. 1997, A. Yamagami leg. Originally stored in alcohol. When studied they were very hard with most of setae worn out; obviously alcohol had evaporated in the meantime.

Most of the paratypes are deposited in the National Science Museum (Nat. Hist.), Tokyo; some duplicates are kept in Canadian National Collection of Insects, Ottawa, Department of Applied Zoology, University of Helsinki, Helsinki, National Museum of Natural History, Washington, D. C., Coll. V. Vikberg, Turenki, and Zoological Institute, Russian Academy of Sciences, St. Petersburg.

Host-plants. *Fagus crenata* Bl., *F. japonica* Maxim. (Momosawa, 1999, 2000).

Biology (observations made at the type locality). The female lays eggs in early spring (from late April to early May) onto the veins of the sprouts of the Siebold's beech tree *Fagus crenata* Bl., which has not fully opened its leaves (Fig. 4 A). The egg is slender, cone-shaped, with the major axis about 1 mm long. The period of the egg stage lasts about one week in the field.

The first instar larva feeds between the veins, making a round hole on the leaf (Fig. 4 B). The second instar larva feeds on toward the leaf edge (Fig. 4 C). After the third instar (Fig. 4 D), the larva devours so voraciously that the host beech tree dense with the larvae may become fully defoliated (Fig. 4 E, I).

The larvae finish development from late May to early June; the fourth (male), or the fifth (female) instar falls onto the ground and then climbs a tree nearby, up to at most about 1 m high where it molts (Fig. 4 H). This mature larva (male in the fifth instar, female in the sixth) is 15 to 20 mm long, with its head milk-white and the skin smooth (Fig. 4 G). Not feeding any more, the larva (prepupa) creeps into the soil and makes a cocoon. In early spring the adult emerges after the short pupal period, probably about one week. The prepupal period can be up to a few years.

Three parasitoids on the larvae have been found; two hymenopterans and one

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dipteran, one of the former, *Cteniscus* sp. (Ichneumonidae, Tryphoninae) being quite common (Yamagami *et al.*, 1998) and the other, *Glyphicnemis* sp. (Ichneumonidae, Gelinae) being infrequent.

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